ASSOCIATION OF

FEDERAL COMMUNICATIONS CONSULTING ENGINEERS

WASHINGTON, D.C.

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Third Periodic Review of the	)	MB Docket No. 07-91
Commission's Rules and Policies	)	
Affecting the Conversion	)	
To Digital Television	)	

COMMENTS OF THE ASSOCIATION OF FEDERAL COMMUNICATIONS CONSULTING ENGINEERS

The Association of Federal Communications Consulting Engineers ("AFCCE"), celebrating over 50 years, is an organization that includes approximately 90 full members who are Registered Professional Engineers engaged in the practice of consulting engineering before the Federal Communications Commission ("FCC"). In addition, AFCCE represents over 160 associate members in allied companies such as equipment manufacturers, service providers and communications law professionals. AFCCE hereby submits comments in response to the FCC 's adoption of the Notice of Proposed Rulemaking, "*In the Matter of Third Periodic Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television*, MB Docket No. 07-91 ("Third Periodic Review").

The Commission is to be commended on identifying the extensive number of issues surrounding the final steps in terminating public off-the-air analog service and the commencement of public off-the-air digital operation. The following comments are respectfully and humbly offered.

The mandate in terminating analog service must occur based upon the date set by law in this Digital Television and Public Safety Act.[1] AFCCE believes that while final construction of DTV facilities must be encouraged, it does not mandate the final construction of the DTV facilities by February 17, 2009. There are many reasons that the Commission should provide reasonable latitude offered to stations in the completion of the final and important step in which the full build out is attained. For example, the Third Periodic Review proposes two stages of application processing - conforming (non-expansion) applications would be granted quickly and they'll accept expansion applications later on an interference basis. For those stations changing channel, the conforming approach can result in a significant overall power reduction due to the Appendix B directional pattern limitations. Additionally, transmission considerations, FCC processing procedures, as well as receiver issues will be addressed.

[1]See Digital Television and Public Safety Act of 2005 ("DTV Act"), which is Title III of the Deficit Reduction Act of 2005, Pub. L. No. 109-171, 120 Stat. 4(2006) ("DRA") (codified at 47 U.S.C. §§ 309(j)(14) and 337(e)).

Transmission and FCC Processing Procedures

The Commission has approved its DTV Table of Allotments[2] issuing the channel, ERP, pattern, transmitter coordinates, and height above average terrain. Some directional azimuth antenna patterns in the DTV Table of Allotments are asymmetrical and unattainable or unrealizable. This whole DTV allotment and filing process while necessary gives rise to unequal treatment. For example, by the "luck of the draw" some stations were given an in-core channel which could be maximized under the so-called 2%-10% criteria. Then there is the question of the two-step conversion process for those DTV stations returning to the analog VHF channel from the interim UHF operation. A more realistic analysis for VHF stations returning back to their VHF channel could have perhaps resulted in converting the equivalent service without the intermediate UHF replication step. Further, the FCC Form 381 and 382 form process should have been more flexible. All the above is not criticizing the process but rather indicates that the Commission must offer those stations returning to their NTSC channel a brief period of perhaps 12 to 18 months to develop applications under the 2% criteria to regularize and complete the station's final DTV destination once it completes its processing of the further round of applications looking toward the February 17, 2009 deadline.

[2]Appendix B, Seventh Report and Order and Eight Further Notice of Proposed Rule Making, released August 6, 2007, MB Docket No. 87-268.

Stations Whose Post-transition Channel Is Different
than Their Pre-transition Channel and
Additional Proposals to Provide Regulatory Relief

Paragraphs 6, 60-66 and 89-91 of the Third Periodic Review discuss scenarios regarding the highly technical issues surrounding the mandatory shut off of analog and the completion of construction of full digital facilities. As discussed in Para 6 and Footnote 17 of the Third Periodic Review, the congressionally mandated analog shutoff date of February 17, 2009 is just that, the shut-off of analog and return of the out-of-core spectrum. AFCCE believes that there is no congressional mandate of full operation of the DTV facilities of that date, although the Commission should mitigate restrictive procedures to further that objective.

In reading the various scenarios outlined in the Third Periodic Review, in paragraphs 60-66 and 89-91, there are minimal discussion and options regarding the obstacles facing stations on UHF that are returning to their VHF channel regarding a short continued temporary use of the digital channel while completing the equipment replacement for the analog channel. AFCCE believes that several factors come into play.

First, there is a high probability that a new DTV antenna will be required for many of these stations because the new Appendix B directional pattern probably does not match their current analog antenna. Because most directional TV transmitting antennas are “custom”, a new antenna could not even be ordered until the Licensee is assured that the required new pattern was “final”. The “final” DTV Allotment Table has only come out in the Report and order in MB Docket 87-268 as of August 6th, 2007 and is currently being reviewed by Licensees and Consultants.

Second, the present VHF analog antenna is more likely than not to be of considerable age and top mounted on the top of tower while the interim UHF DTV antenna is most likely to be side-mounted.

Third, the analog cutoff date is in the dead of winter so that replacement "just before" the cutoff date could be expected to be delayed significantly because of winter weather conditions particularly in northern states and Alaska. Replacing a multi-ton antenna must be done when wind velocities are below 5-7 miles per hour, something that happens rarely at the top of a tower in winter.

Fourth, replacing the analog antenna with the digital antenna prior to the analog cutoff date, for those stations not having an analog standby antenna, which would include many NCE and small market stations, would require the station's analog service being interrupted, possibly for many weeks depending on weather, prior to the transition date.

Fifth, there exists, as has been shown by Capitol Broadcasting[1] and referenced by the Commission in the Third Periodic Review, that there are many obstacles to a quick replacement of antennas, transmission lines, and transmitters as well as not nearly enough qualified tower riggers to be able to handle all the required replacements in a timely manner with a fixed cutoff date as proposed herein without either completing the construction before or after the cutoff date.

AFCCE believes that the public interest would be served by not requiring stations, as described herein, to temporarily suspend analog operations prior to February 17, 2009, to replace an existing analog antenna with a new digital antenna, and that the staff would have authority,

[1] See NOTICE, Para 22, Footnote 49.

upon proper showing, to allow UHF DTV stations returning to their analog VHF channel to operate their pre-transition UHF DTV service for a short time, if necessary, beyond the analog shutoff date to facilitate the existing analog antenna replacement after the termination of analog service. This option would be conditioned on a showing that continued pre-transition operation being necessary because a standby antenna system was not available or the supporting tower did not have structural capacity to support a standby antenna, the antenna and installation materials have been timely ordered to insure delivery in time for immediate replacement after February 17, 2009, a qualified tower crew is available to complete the required work, the operating digital pre-transition facility is in-core, and that no interference would be caused to any other station as a result of this temporary operation. AFCCE suggests that a maximum of 60 to 180 days be permitted for this operation.

Interference at Band Edges

This item is not included within the context of the Third Periodic Review, but AFCCE believes that it is timely to consider interference requirements at the new DTV band edges, particularly with respect to interference caused by existing and new facilities operating on adjacent spectrum.

The current requirements for DTV transmitters for causing adjacent channel interference suppression are quite extensive as outlined in 73.622(h). For NTSC stations operating as NTSC on Channels 14 and 69, existing rules 73.687(e) outline required reductions in out of band emissions to protect land mobile operations at +/- 3 MHz. AFCCE believes that the requirements of 73.622(h) for DTV stations already exceed this requirement.

However, AFCCE also believes, absent any actual measured data, that rules should at least be codified as to the reception protection of DTV band edge stations on Channels 2, 6, 7, 13, 14, and 51 similar to current first adjacent channel DTV-DTV and DTV-NTSC requirements of 73.622(c)(2) to fully protect DTV receivers for any interference caused by any services operating on RF frequencies immediately adjacent to operating DTV stations and within any locations likely to cause interference within the DTV station protected contour.

Antenna Relative Field Specifications

The Commission has assigned each station an antenna pattern defined in terms of relative field values at 10º azimuthal increments (maximum value 1.00). While most analog stations operate with omnidirectional patterns (i.e., RF = 1.0 for all azimuths), the assigned DTV patterns rarely have a value of 1.0 for all azimuths due to the methodology employed by the Commission in which terrain (HAAT for a particular azimuth) and frequency ("dipole factors" and band-specific propagation curves) influenced the determination of the assigned relative field values. Thus, in most cases, a station having an omnidirectional analog radiation pattern was assigned something other than that for its DTV allotment. Antenna manufacturers cannot produce these hypothetical patterns in practical antennas leaving the station with the option of reducing power (ERP) if using an omnidirectional antenna to keep the radiated field within the values specified by the Commission for each azimuth. The Commission should permit some leeway in matching the assigned pattern with a practical antenna. It is suggested that 0.5 dB would be an appropriate value for the maximum difference between the assigned RF value and the directional antenna pattern assigned by the Commission.

Finally, it is noted that the beam tilting provision in the Rules does not apply to VHF stations. AFCCE believes that there is not any valid reason for denying VHF DTV stations the option of the same technique. This will be particularly helpful to VHF stations with high antennas close to the urbanized area of their markets where the low ERP's inherent in most situations become effectively lower for close-in locations due to the antenna elevation patterns. This short-fall will have significant adverse impact on the ability to provide adequate field strengths for indoor antenna reception; the beam-tilting approach would permit higher fields to be provided close-in increasing the probability of being able to provide for indoor-reception in the urbanized areas.

On a related matter, in cases where "omnidirectional" antennas were used in the analog service, the general practice of the industry, accepted by the Commission, has been to consider a relative field pattern which varies less than 2 dB (in azimuth) as non-directional. Furthermore, applicants have used the manufacturer's RMS value of antenna gain when computing the effective radiated power to be specified to the Commission. The Commission should clarify and extend this practice for DTV applications, i.e., an antenna would be considered non-directional if the azimuthal field variation is less than (plus or minus) 2 dB with respect to the RMS value of the pattern and, further, that the applicant may employ the RMS gain value when computing the ERP filed with the Commission.

Antenna Vertical Patterns

As the spectrum becomes ever more crowded it becomes increasingly important to use the best engineering to determine what changes to existing stations or new stations can be authorized without causing interference. The failure to use actual antenna vertical patterns is a failure to use the best engineering practice. It is recommended that the following provision be added:

> Interference calculations performed to determine whether an application to modify an existing station or to obtain an authorization for a new station shall include the manufacturer provided vertical pattern and electrical downtilt if not already included in the pattern. This pattern will be used in performing the outgoing interference calculation.
>
> If a protected station does not have a vertical pattern on file the standard FCC vertical pattern shall be used. However, if necessary to establish non-interference an applicant may request that the actual vertical pattern of a protected station be provided by the potentially affected licensee, permittee or applicant. If this protected party fails to provide the actual vertical pattern the applicant may request that the manufacturer's standard vertical pattern for the specified antenna be substituted for the FCC vertical pattern.

The Commission's Rules [73.622(f)(4)] provide for the use of higher than normally permissible ERP if excessive beam tilting is employed. Applicable only to UHF-DTV facilities, the theory is that a higher ERP can be used to provide greater field strengths within the station's service area while maintaining (or not exceeding) a limiting field strength at the radio horizon. The rules currently impose a 1 dB penalty on the proponents of such operations which, in some cases, negates much of the benefit which may be derived by using this methodology. A review

of the documentation in this proceeding provides little guidance as to the origin of this 1 dB penalty and, therefore, it appears to be quite arbitrary, i.e., without sound scientific basis. Perhaps it was intended to provide a buffer or safety margin to account for antenna sway (structural), beam steering (beam tilt variation with frequency across the channel) or just ordinary manufacturing and installation variables.

It is submitted that the magnitudes of these variables are very small compared to the signal attenuation that occurs at and beyond the radio horizon in a normal propagation path. Therefore, it is further suggested that the 1 dB penalty be rescinded to permit stations to employ large beam tilts and higher ERP's (at depression angles below the depression angle of the radio horizon) provided that the calculated field at the radio horizon does not exceed the field value calculated to be produced if the maximum authorized ERP occurred at the depression angle to the radio horizon.

It is further recommended that the pertinent rule contain a proviso that the relative field value of the elevation pattern at any point <u>above</u> the depression angle to the radio horizon may not exceed the relative field value at the radio horizon.

<u>Receiver Issues</u>[2]

On March 16, 2005, Mr. Charles W. Rhodes made a presentation to AFCCE on the results of recent experimental investigations entitled, "DTV-DTV Interference Considerations." Figures extracted from that presentation are as follows:

[2]Special acknowledgment to Mr. Charles W. Rhodes–see *TV Technology* issues, June 27, 2007, Volume 25, No. 14, Page 48 and July 25, 2007, Volume 25, No. 16, Page 42

- Figure 4 - introduces the concepts of what a distorted DTV signal looks like after passing through a non-linear amplifier such as a TV Tuner. Note that the IM products fill both adjacent channels.

- Figure 33 - shows two DTV signals on adjacent channels. The IM is significantly higher when two DTV signals are present as can be seen by comparing the shaded area under the curve of Figure 2 and Figure 33. Note that two adjacent DTV signals and their IM extend over 4 channels.

- Figure 34 -- shows two DTV signals with one channel between them. Note that the IM products are substantially at the same power in 5 nearby channels. The spectrum of these two DTV signals with their IM now fills 6 channels.

- Figure 35 -- shows two DTV signals with two channels between them. Now the spectrum of these two signals and their IM fill 60 MHz, 10 channels.

- Figure 36 also shows two DTV signals but with 3 channels between them. Vacant three vacant channels and ten channels of signals or distortion products occupy 78 MHz.

Mr. Rhodes stated that "the situation is much more complex when there are three or more DTV signals in clusters of DTV signals with their IM products." This situation is frequently found in major markets. Further research is needed to fully understand the potential such clusters may create for unanticipated interference. Cluster of three DTV signals were also disclosed in recent issues of IEEE Transactions on Consumer Electronics February, 2007 Vol. 53, Number 1 by Charles W. Rhodes, see figures 9 and 10 page 79."

The FCC Laboratory Report on Interference Rejection Thresholds of Consumer Digital Television Receivers ("FCC Laboratory Report") available in 2005 and 2006 dated March 30,

2007[3] provides valuable insight to the current generation of DTV receivers. It is extremely important that the consumer be able to buy DTV receivers whose performance match the Commission's allocation scheme.

It appears that recently produced modern DTV receivers are more robust against first-adjacent channel interference ("ACI") than for second adjacent channel interference. While there are desired to undesired ("D/U") protection ratios for DTV-DTV first adjacent channel interference there are no protection ratios for second adjacent channel interference. Therefore the Commission may wish to review the FCC Laboratory Report and modify Part 73 of its rules accordingly, to provide protection ratios for second adjacent channels to include second adjacent channel.

From the FCC Laboratory Report, it appears that ACI is due to receiver non-linearity, not limited IF selectivity as was the case when the analog TV services were planned. At that time a single D/U ratio worked well over the entire range of desired received power. Now different U values are appropriate over the range of D levels to provide needed protection while maximizing spectrum efficiency.

From the FCC Laboratory Report, it appears that DTV to DTV Interference in the UHF band is also due to third intermodulation products ("IM3"), not cross-modulation of the desired signals by an undesired signal.

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[3] *Interference Rejection Thresholds of Consumer Digital Television Receivers Available in 2005 and 2006*, dated March 30, 2007, Technical Research Branch Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, OET Report, FCC/OET 07-TR-1003, prepared by Stephen R. Martin

However, it has recently been shown that DTV-DTV interference in the UHF band from signals on certain channel pairs of the form N+K, N+2K (K is an integer ±), is the dominant interference mechanism as one 1M3 produced by signals on such channels pairs falls in the desired channel (N). These IM products are generated in the tuner, usually in the mixer, when the total signal power of signals on such channel pairs exceeds the linear portion of the dynamic range of said mixers. Therefore, it is appropriate that the FCC establish a set of maximum U signal powers based on the maximum IM3 generated by D levels from say D min. + 3 dB up to D = -28 dBm.

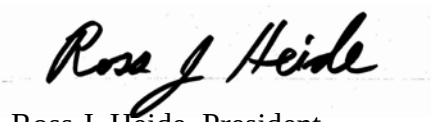
The FCC Laboratory Report demonstrates that one undesired signal on channel N+7 can cause interference to DTV reception of a signal on channel N. The underlying mechanism has not been determined, but this interference is significantly greater than that due to image frequency Interference (N+14, N+15).

Therefore, the Commission needs to take steps within its regulatory framework to establish clear and concise guidelines or rules to ensure that the public and the consumer are able to buy a DTV set that operates in conformance with the FCC allocation standards.

Finally, DTV-DTV interference can result when multiple signals are present at the receiver input, tightly packed in frequency, so that multiple signals reach the mixer, and receiver overload results. RF selectivity of DTV receivers must be improved, especially in the UHF band.

AFCCE finally encourages the Commission in this last important transition step to DTV to issue guidelines or rules to improve tuner selectivity and mixer dynamic range under the current umbrella regarding eight level Vestigial Side Band (8-VSB)[4].

Respectfully Submitted,



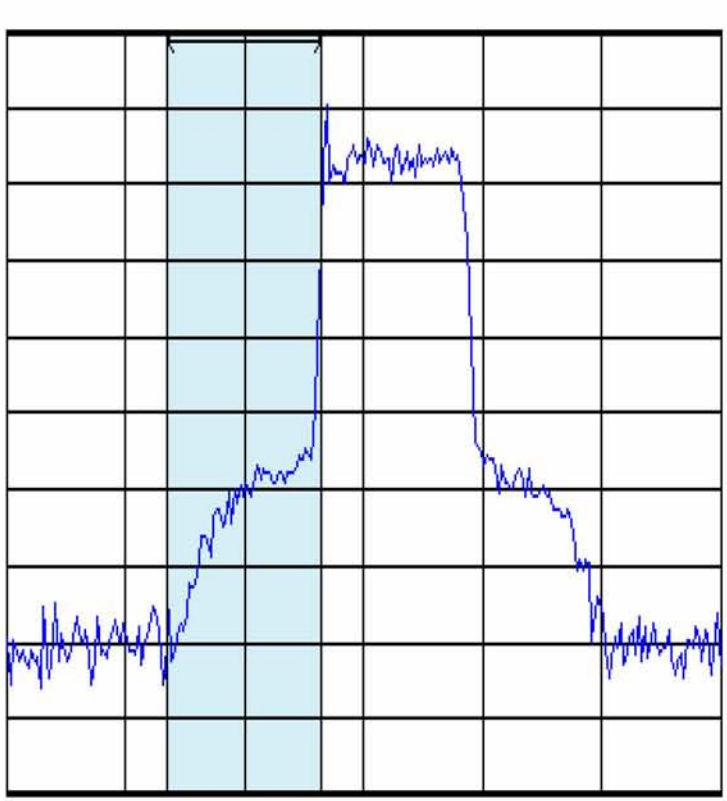
Ross J. Heide, President
AFCCE

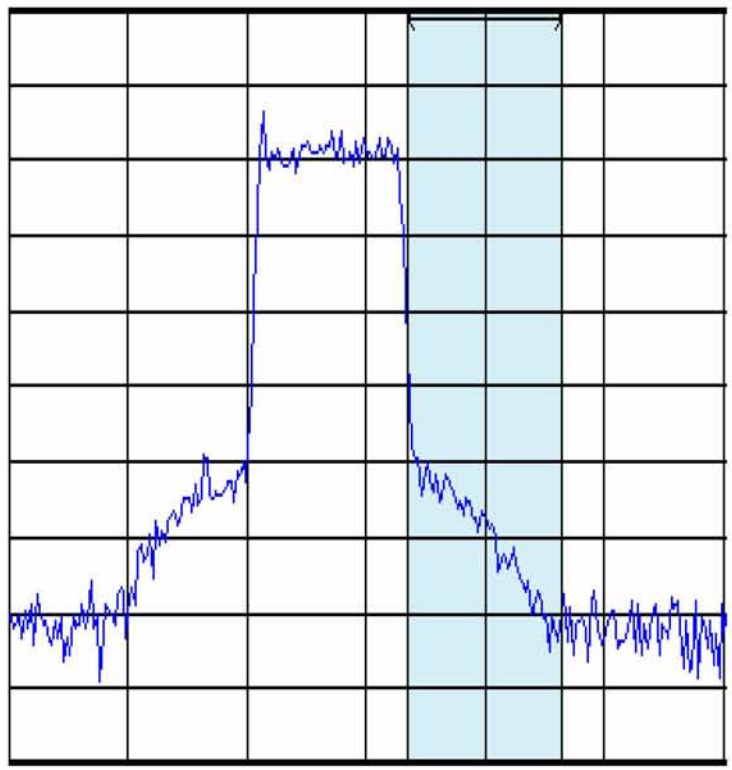
Date: August 15, 2007

[4]8-level Vestigial Side Band (8-VSB) is the over-the-air digital television (DTV) transmission format specified by the Advanced Television Systems Committee's (ATSC) Digital Television Standard (A/53) and adopted by the FCC as the U.S. standard for terrestrial DTV broadcasting.

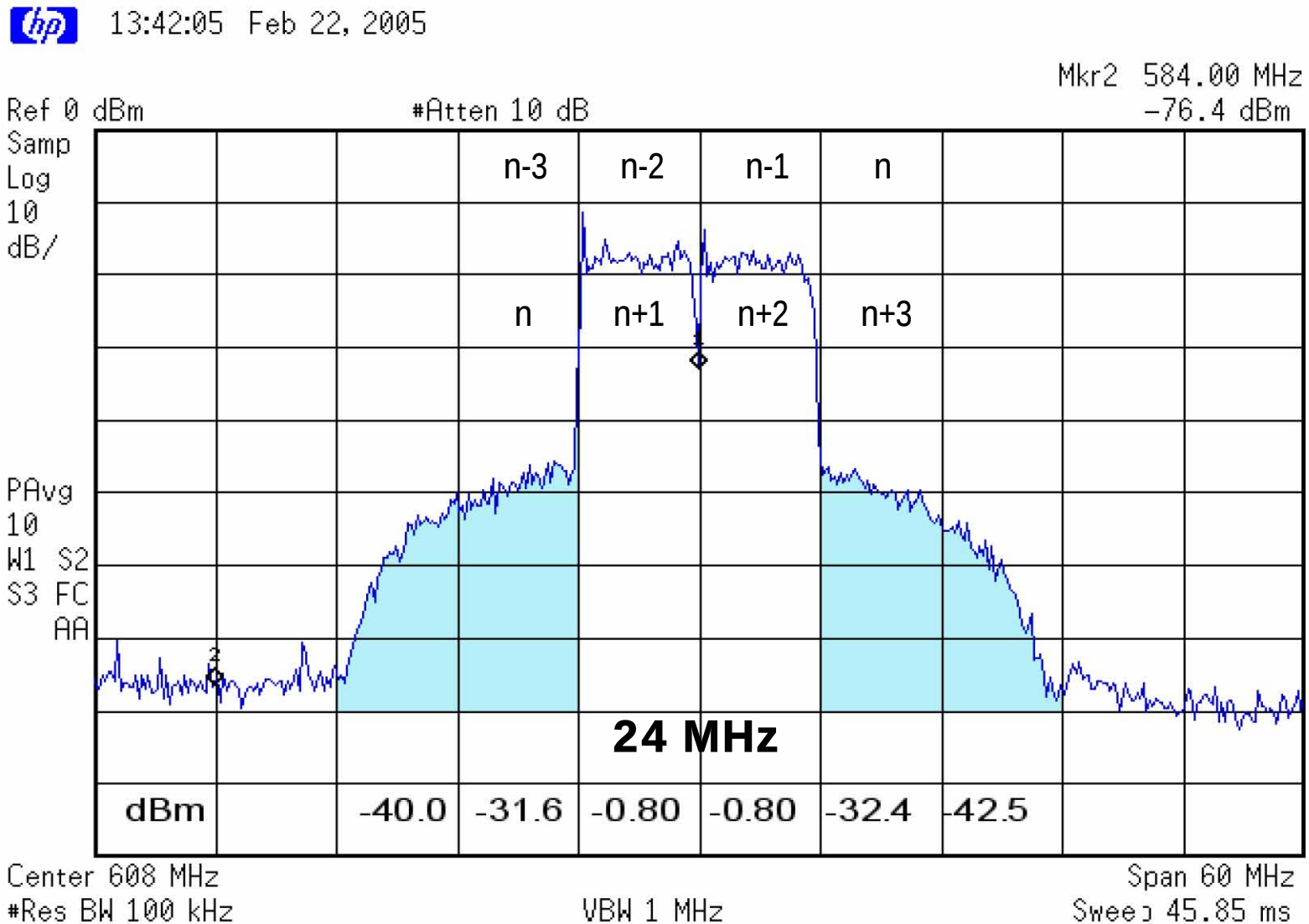
3rd Order Non-Linear Distortion

DTV transmitters and receivers both generate 3rd order distortion products (IM3) which fall in the first adjacent channels, n-1 and n+1.

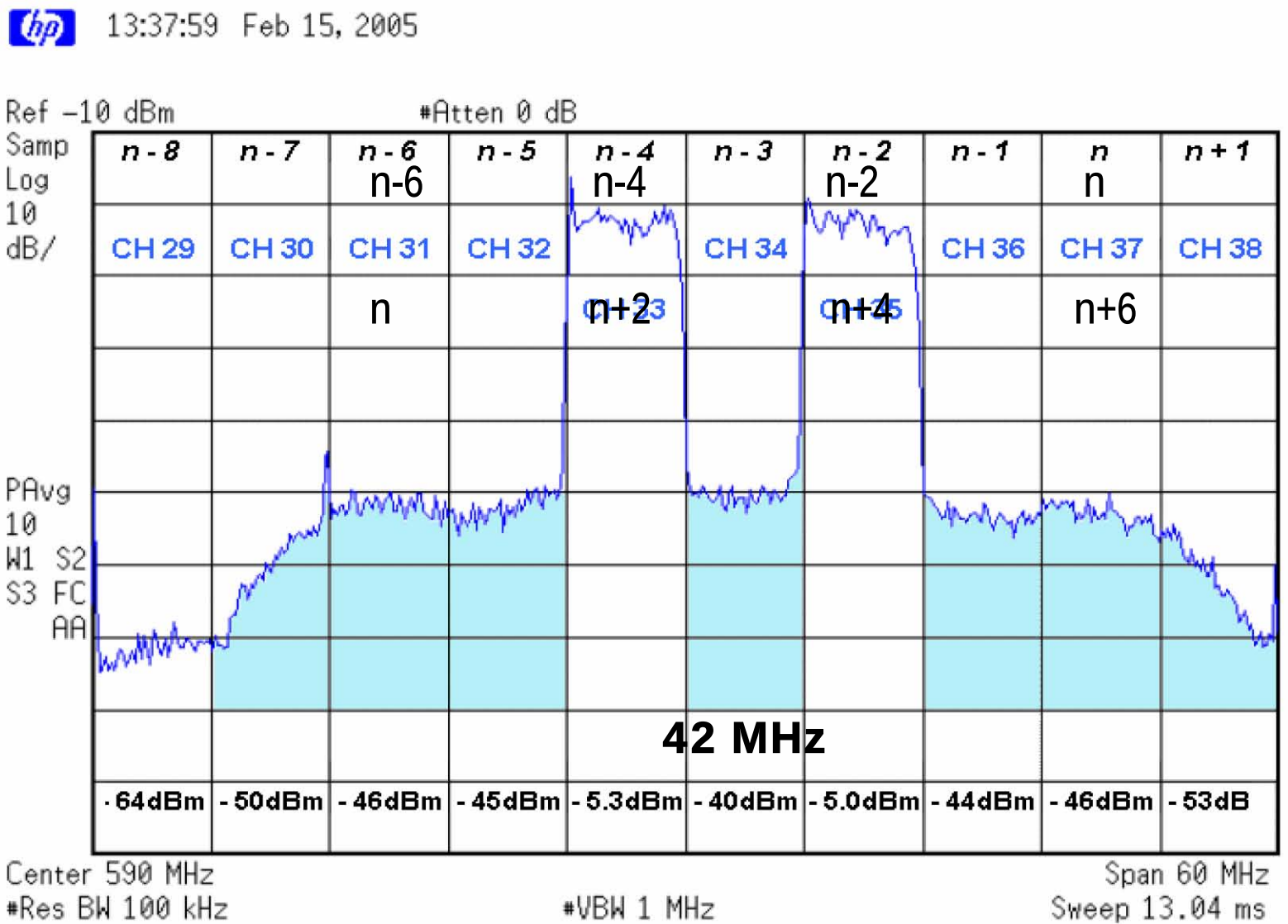




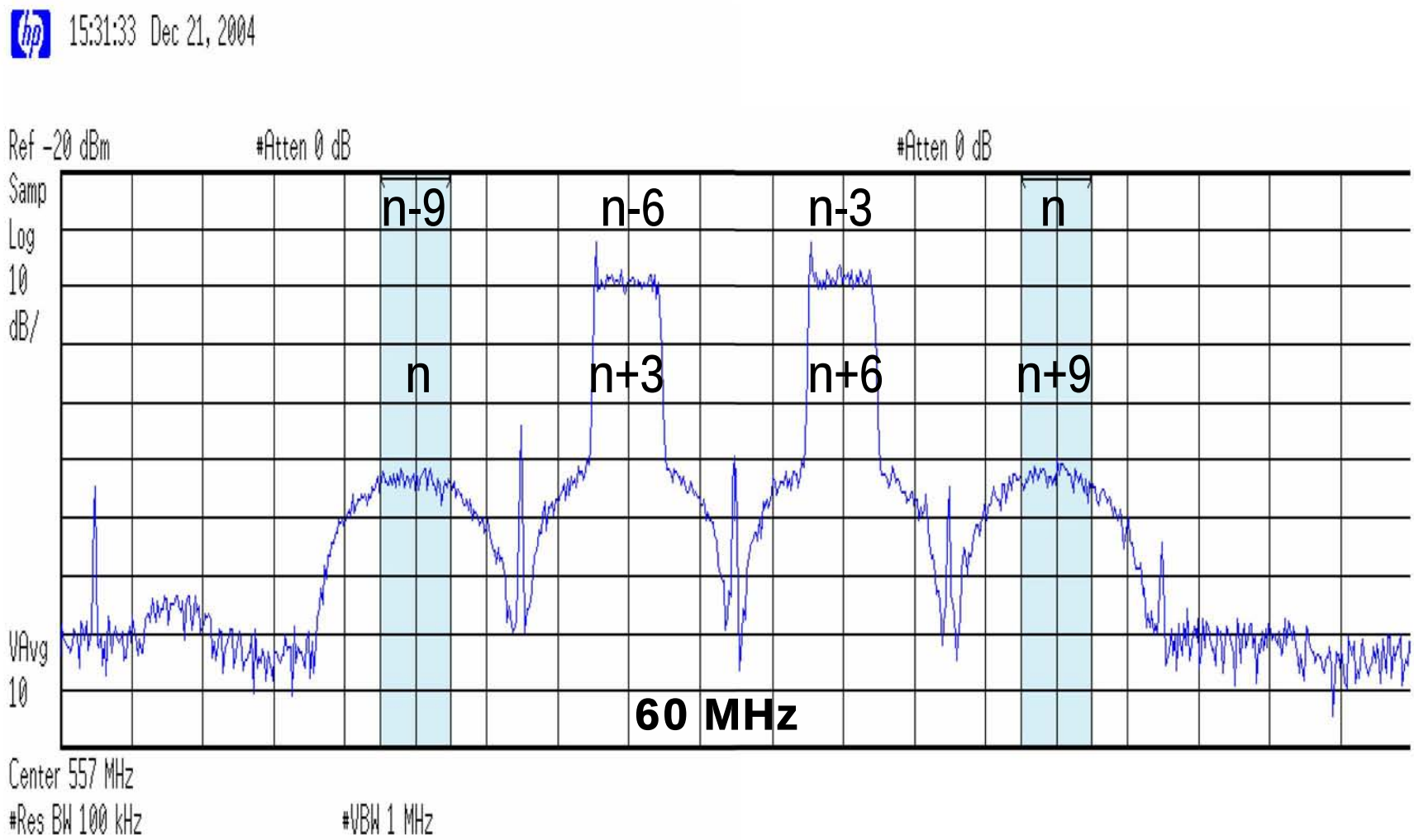
Interference into (n) from the [n-2, n-1] and [n+1, n+2] Channel Pairs



Interference into (n) from the [n-4, n-2] and [n+2, n+4] Channel Pairs



Interference into (n) from the [n-6, n-3] and [n+3, n+6] Channel Pairs



Interference into (n) from the [n-8, n-4] and [n+4, n+8] Channel Pairs